Amendment Under 37 C.F.R. § 1.116
Serial No. 10/031,872
Sughrue Ref: Q68112

AMENDMENTS TO THE SPECIFICATION

Page 1, first paragraph, please amend as follows:

This invention relates to an antiroll and anti-pitch system for a vehicle, and to the devices for its implementation, specifically a system to be applied to vehicles provided with four ~~sets of one or more~~ wheels. The system either cooperates with the vehicle's suspension system or substitutes for the vehicle's suspension system in order to allow the four sets of wheels to keep contact with the ground and to keep an even distribution of load even if the vehicle is subject to uneven terrain. Where the sets of wheels are provided in a two-by-two manner, the sets that diagonally oppose each other are related in such a way that the loads created by the vertical movements of one of the sets are transmitted to the opposite set in order to transmit such a force that creates a similar movement in the vertical direction of the opposite wheel. The system cooperates with the suspension of the vehicle, or is substituted for the suspension of the vehicle in order to allow all of the vehicle's wheels to keep contact with the ground even if the terrain is irregular and prevents unwanted effects that are caused by the uneven terrain.

Page 2, paragraph 8, please amend as follows:

In U.S. patent 2,840,387, the forces created in a vehicle wheel as it turns are transmitted by two tie-rods to the diagonally opposed wheel, which reproduces the force in the same direction~~,~~. In US patent 3,147,990, the wheels on one side of the vehicle are connected to each other and also to those on the other on the other side by means of torque arms. In U.S. patent

3,992,026, right and left torsion bars generally extend in the longitudinal direction and interconnect the right and left sides of a front anti-roll bar with right and left rear suspension arms, respectively. In U.S. patent 5,505,479, two front suspension lower arms are aligned transversally between opposite front and rear wheels, and connected by a resilient element located longitudinally, for the purpose of transforming the vertical movements of the wheels into a rotary motion as seen from the front of the vehicle. U.S. patent 5,882,017, a perpendicular connecting rod is coupled to the vehicle and a pair of articulating elements link such connecting rod to the front wheels, including a pair of travel limits selectively actuated that communicate with the central part of such connecting rod.

Page 4, paragraph 13, please amend as follows:

The invention assumes that the forces created by the vertical movements from one ~~set of wheels are~~ wheel is transmitted to the diagonally opposite ~~onset of wheels~~ wheel either through mechanical means able to resiliently resist forces of traction, compression, torsion and flexion, through hydraulic means, through pneumatic means or through electrical or electronic means used to command servo actuators on each wheel. These means can be provided either separately or any combination.

Paragraph 15, please amend as follows:

As in this invention, an anti-roll and anti-pitch device for a vehicle comprises a receiving element connected with a first ~~set of wheels~~ wheel of the vehicle, which transmits the wheel

vertical movements to a direct transforming element that converts the vertical movements into horizontal movements. An inverse transforming element converts these horizontal movements into vertical movements that are transmitted to a second wheeling set diagonally opposed to the first wheel, causing a vertical movement analogous to the movement of the first wheel.

paragraph 17, please amend as follows:

One characteristic of this invention is the case where receiving and actuating elements are made of a rod connected on one end to one ~~wheeling set~~ wheel through a universal joint, while the other end is articulated to a direct transforming element in the receiving end case, and to an inverse transforming element in the case of an actuating element. In this case, the direct transforming element is a first kind angled connecting rod, and the inverse transforming element is a second or third kind angled connecting rod, which pivot points are supported by the vehicle body through bearings.

Page 6, paragraph 23, please amend as follows:

There is another preferred implementation where the interaction means that are related with each pair ~~of sets~~ of wheels is built as a central hydraulic device made of three concentric coupled cylinders, closed at the ends of the set, where the central cylinder is of a larger diameter, and the two cylinders at its sides are both of equal diameter, having inside the cylinders two

double-pistons, with no external rod, and one larger piston found inside the central cylinder, and a smaller piston in one of the smaller cylinders, in such a way as to determine five cavities: one central cavity, and two pairs of cavities at each side of the device separated by the smaller diameter pistons, being the double cavities at each end of the device connected respectively to the hydraulic conduits corresponding to hydraulic single effect rams at each diagonally opposed wheeling set, while the central cavity is connected to an actuating device built with resilient means and/or a fluid susceptible of being connected to an expansion chamber that opposes to the two double pistons getting closer to each other.

Page 7, paragraph 28, please amend as follows:

The invention contemplates the following facts:

a) Hydraulic fluid regulation or damping devices are inserted in the hydraulic conduits from the central device to each hydraulic ram linked to the wheeling sets, or in between the cylinders associated to conjugated ~~wheeling sets~~wheels.

b) The central cavity, the two pairs of side cavities, the conduits that connect these with the hydraulic rams at each wheeling set, or the hydraulic cylinders can be connected to one or more expansion pneumatic chambers through electro valves.

c) The four conduits that connect the double side cavities from the central hydraulic device to each hydraulic ram at the ~~wheeling sets~~ wheels is susceptible of being communicated through devices that allow a limited volume flow depending on the pressure differential between

the conduits, being these devices preferably applied between conduits to ~~wheeling sets~~ wheels at the same side of the vehicle.

Page 9, paragraph 30, please amend as follows:

FIG. 1 is a diagrammatic representation of the anti-roll and anti-pitch suspension system for a vehicle.

FIG. 2 is a diagrammatic representation of the device that relates two diagonally opposed wheels through a single push-pull strut.

FIG. 3 is a diagrammatic representation of the device that relates two diagonally opposed wheels through a single torsion bar.

FIG. 4 is a diagrammatic representation of the device that relates two diagonally opposed wheels through an articulated torsion bar.

FIG. 5 is a diagrammatic representation of the device that relates two diagonally opposed wheels through a pair of pull-only flexible stays.

FIG. 6 is a diagrammatic representation of the device that relates two diagonally opposed wheels through single effect hydraulic rams

FIG. 7 is a diagrammatic representation of the device that relates two diagonally opposed wheels through servo actuators and an electrical/electronic circuit.

FIG. 8 is a diagrammatic perspective representation of the transverse configuration for the wheels torsion bars related diagonally in pairs through two transmission bars crossing over at some point.

FIG. 9 is a diagrammatic perspective representation of rear side of configuration showed in FIG. 8 where such transmission bars are connected to the vehicle body through independent resilient elements.

FIG. 10 is a diagrammatic perspective zoomed representation of the resilient elements in FIG. 9.

FIG. 11 is a diagrammatic representation of a configuration similar to FIG. 9 where the independent resilient elements are placed at a mid point of the transmission bars.

FIG. 12 is a diagrammatic zoomed perspective representation of the configuration of FIG. 11.

FIG. 13 is a diagrammatic representation of a detail like FIG 12 where the two resilient elements are not independent and are related through a balance beam.

FIG. 14 is a diagrammatic representation of a detail like FIG 10 where the two resilient elements are not independent and are related through a balance beam.

FIG. 15 is a diagrammatic perspective representation of transverse configuration based on torsion bars where the transmission bars are equally crossed and connected through a common resilient element in this case under compression.

FIG. 16 is a diagrammatic perspective representation of a longitudinal configuration based on torsion bars where the transmission bars are located transversely.

FIG. 17 is a diagrammatic perspective representation of a configuration for a four-wheel vehicle based on torsion bars related through crossed transmission connected to a common resilient element.

FIG. 18, 19 and 20 are is a diagrammatic perspective and zoomed representations of details of FIG 17.

FIG. 21 is a diagrammatic representation of a hydraulic device with simple effect rams applied to the four vehicle wheels.

FIG. 22 is a diagrammatic representation of a hydraulic device with simple effect rams applied to the four vehicle wheels.

FIG. 23 represents a section of the implementation of the central hydraulic device found in previous FIG.

FIG 24 represents a perspective section of the implementation of the central hydraulic device found in FIG 22.

FIG 25 is a diagrammatic representation of an alternative implementation of the central hydraulic that has is functionally equivalent to the device represented in FIG 22 and 23.

FIG 26 is a diagrammatic representation of multiple expansion chambers that allows the adjustment of suspension stiffness.

FIG 27 is a diagrammatic representation of limited volume transfer to be inserted between two hydraulic circuits.

~~Figs. 28 and 29 show additional embodiments.~~

Page 12, paragraph 46, please amend as follows:

FIG 13 shows a configuration where the two coil springs 27 linked to the transforming elements ~~26~~26A, 26B are related with the vehicle body through the balance beam 34, linked to

the vehicle body through an axis going through the pivot point 35, and to the rods 32 at its ends, having like the previous case pushing ends 33.

Page 13, paragraphs 50 and 51, please amend as follows:

FIG 17 is a representation of a mechanical layout similar to FIG 15 where the transmission elements 26A' and 26B' are arranged on the same plane, side by side through the single coil spring 27 mounted between the brackets 37, each of them joined to fixtures 38 and 39 each linked to one transmission element 26A' and 26B' as shown in the detail view 19.

As it can be seen in figures 18 and 20, the transmission elements 26A' and 26B' are crossed over by means of the connecting arms 24A-24D, so the arm 24B is related to arm 24C, and arm 24A to arm 24D.

Page 14, paragraph 53, please amend as follows:

FIG 21 shows a variation where each receiving and actuating element of the two pairs of vehicle wheels is made up by the rods 40 of pistons 41 of single effect hydraulic rams 42, the direct and inverse transforming elements are arranged in a unique central hydraulic cylinder 43 containing two free moving and opposed pistons 44. Active areas 45 are equal and concentric, and are subject to an internal actuator made of a coil spring 46 and/or pressurized fluid 47 On the outer side of each piston, a cylindrical compartment 49 and a coaxial compartment 50 correspond to the active sections of each piston. Each compartment 49~~5~~0 and ~~50~~49

communicates with a connection 51 that extends towards the corresponding receiving and actuating element 40 for each of the diagonally opposed wheels.

paragraph 56, please amend as follows:

FIGs 22 and 23 represent a variation where the central hydraulic cylinder 43' is made up joining three hollow concentric cylinders, with a central cylinder 52 has a larger diameter, and the side cylinders 53 are the two equal and of smaller diameter, closed at their free ends 54. Inside such hollow body there are two free moving double pistons 55 made up one larger diameter piston 55A placed inside the larger central cylinder 52, and a smaller piston 55B placed inside the corresponding end cylinder 53, thus determining one larger central cavity 56 associated to the central cylinder, 52, two smaller intermediate cavities 57 and 58, and two smaller ending cavities 59 and 60 associated to the side cylinders 53, all cavities connected in such a way that the smaller intermediate cavities 57 and 58 are respectively communicated with the simple effect hydraulic ram 42 for wheels B and A, while the smaller end cavities 59 and 60 are respectively communicated with the simple effect hydraulic ram 42 for wheels C and D. The central cavity 56 has an actuating device made of resilient means such as pressurized fluid 62, coil spring 46 or rubber-like body, the two last cases not represented in Figs. 22. One preferable implementation of such central hydraulic device 43' is shown in figures 23 and 24.

Page 15, paragraph 58, please amend as follows:

The resilient means used in the actuator in the central cavity can be made of a double resilient element that independently pushes pistons 55A that close such larger central cavity 56. Another possibility is to divide the central hydraulic device 43' in two halves that communicate through an additional conduit that has means to regulate the flow of the fluid. ~~This is shown in Fig. 28.~~

Pages 15 and 16, paragraphs 60, 62 and 62, please amend as follows:

FIG 22 shows how two-way regulation or damping devices 67 are inserted in the pipes and connect the central hydraulic device with all simple effect hydraulic cylinders 42 associated with the wheels. Additionally, the larger central cavity 56, the smaller intermediate cavities 57 and 58, the end cavities 59 and 60, the hydraulic conduits 61 that connect the cavities with the hydraulic rams 42 associated to each wheel and the very hydraulic rams 42 are connected to the damping devices 67, which can be one or several pneumatic expansion chambers 68 that can be disconnected through ~~electro-~~electric valves 69, such as these represented in FIG. 26.

On the other side, the four main hydraulic conduits 61 that connect the smaller cavities 57, 58, 59 and 60 of the central hydraulic device 43' with the simple effect hydraulic rams 42 associated to the wheels are susceptible to be connected among them through devices that allow the flowing of a limited quantity of fluid depending on the pressure differential between the hydraulic conduits. This communication is preferably applied between hydraulic conduits from wheels of the same side of the vehicle. FIG 27 shows this device made up with a free-moving

piston 70 between two coil springs 71 inside cylinder 71. ~~Fig. 29 shows an arrangement including this communication.~~

It has also been anticipated having means to provide pressurized hydraulic or gaseous fluid or drain it from the larger central cavity 56 with the purpose of varying the average distance between the vehicle body and the wheels. For example, Fig. 21 shows an entry M of fluid pressurized by a pump P, and Figs. 23 and 24 show an entry M'. The same result is obtained including a mechanical device that pushes the two larger diameter pistons 55A placed in the central cavity 56 in the central hydraulic device 43.

Page 17, paragraph 66, please amend as follows:

The invention also contemplates the fact that a wheel set of can be used in place of individual wheels. ~~w~~When ~~the wheeling sets are made up of~~ more than one wheel is used, each wheel has ~~with the~~a corresponding single-effect hydraulic ram, and all the hydraulic rams for the wheel set are connected to each other and to the hydraulic central device through the conduit corresponding to the wheel set.